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Mechanical and Neuromuscular Investigations within Static and Dynamic Simulations of Ankle Joint Injuries

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MECHANICAL AND NEUROMUSCULAR INVESTIGATIONS WITHIN STATIC AND DYNAMIC SIMULATIONS OF ANKLE JOINT INJURIES

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INTRODUCTION

Prospective epidemiological studies have shown that external ankle support by means of bracing and taping reduces the incidence of acute ankle injuries. Since external ankle support has been reported to have little or no effect on performance, it is often used in high risk sports – like volleyball, basketball, soccer. The effectiveness of external ankle support has been investigated in biomechanical studies by means of trap door or tilt platform mechanisms with 20 to 40 degrees of inversion, sometimes in combination with 5 to 15 degrees of plantarflexion using electrogoniometers for mechanical and surface electromyography for neuromuscular evaluation (Alt et al., 1999). Authors predominantly used single leg stance in order to load the tested leg with body weight, accepting the static character of the test situation. The average inversion velocity was in the range of 300 – 600 degrees per second. In order to create a more dynamic test situation, a different experimental set-up has been reported by (Nieuwenhuijzen et al., 2002): ankle inversions of 25 degrees were elicited using a trapdoor located slightly above a treadmill. With subjects walking at a speed of 4 km/h and stepping on the trapdoor or landing on the box from a jumping height of 0.3m, the authors saw inversion velocities of up to 600 degrees per second during the landing task, with anticipation perhaps being a problem during the walking task. Ubell et al. (2003) used a dynamic set up also, in which subjects wore dummy or inversion soles under shoes, with no or 24 degrees of inversion to investigate stabilizing effects of ankle braces. All braces reduced inversion but neuromuscular effects have not been reported. The purpose of the developed dynamic injury simulator is to evaluate the mechanical and neuromuscular effects of ankle bracing by inducing an ankle inversion of 25 degrees and 10 degrees of plantarflexion during bipedal landing tasks from 0.38m jumping height without any anticipation possible.
First results reveal inversion velocities of around 1000 degrees per second as well as peroneal reflex latencies of 35 to 40 ms with maximum amplitudes of around 1,5 mV.

METHODS

Our experimental setup consists of a shoe-system with easily interchangeable carbon soles. We use a dummy inversion sole setup which leaves subjects unaware of whether and on which side the simulated inversion trauma will occur.

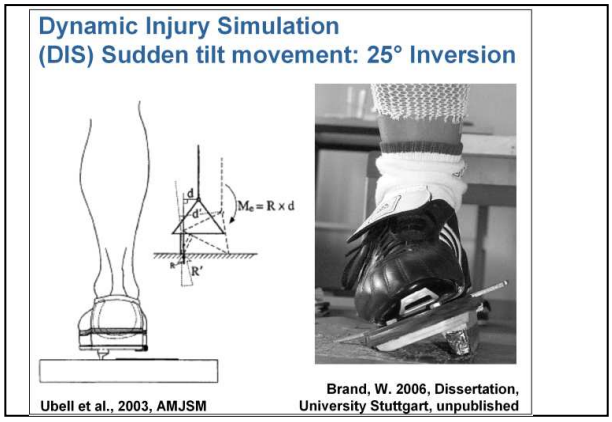

Fig. 1: Modified shoe with special interchangeable carbon soles inducing 24° inversion during landing.

RESULTS

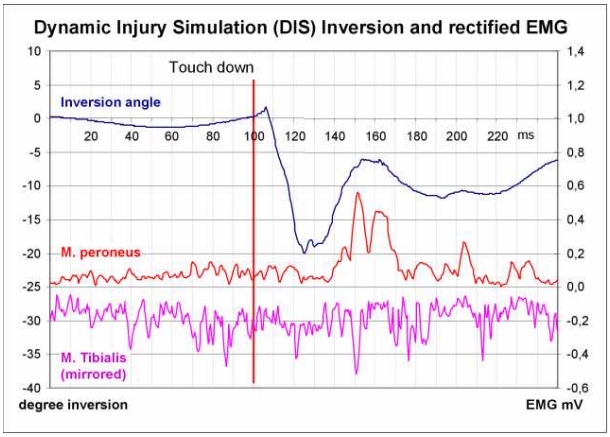

Fig. 2: Example of EMG (rectified) from m. peroneus and m. tibialis (rectified and mirrored) and inversion angle during landing from 38 cm height. (Note the short latency of peroneus muscle).

From a functional point of view, there is clear evidence that dynamic injury simulation creates a much higher inversion velocity (1200 degrees per second) compared to static trap door or tilt platform mechanisms (about 600 degrees per second) and is hence closer to the real trauma paradigm. The peroneal reaction time is much shorter compared to static injury simulation.

CONCLUSION

It seems that the new developed method provides a more realistic evaluation of prophylactic ankle bracing.

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